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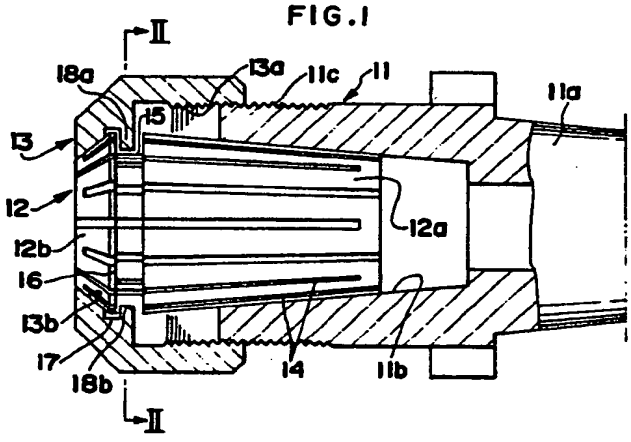
(54) Collet Chuck.

(57) A collet chuck, comprising the main body (11) of the chuck, a collet (12) which is fitted into the main body thereof, and a fastening nut (13) for chucking a cutting tool which is screwed into the main body of the chuck under the state where the fastening nut is detachably connected to the collet, thereby reducing the diameter of the collet, wherein an external flange (16) is provided on the collet (12), internal flanges (18a,b) are provided on the fastening nut (13), and while holding of these flanges (16, 18a,b) into one another permits the collet (12) and the fastening nut (13) to be detachably connected to each other, a pair of cutout sections (19) opposite to each other are formed on the inward flanges (18a,b) of the fastening nut (13) so that the mounting and detaching operation may be easily made.

FIG.1



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Collet Chuck

The present invention relates to a collet chuck for mounting a tool such as drill, end mill and like to a rotary spindle in various kinds of machine tools.

Related Background Art

The collet chuck which has conventionally used comprises a main body of a chuck having a taper hole at its top end part, a collet having a taper surface which is detachably fitted into the taper hole at its external periphery, and a fastening nut which is fitted around the collet and, at the same time, is detachably screwed on the main body of the chuck, and is constructed such that the collet, capable of being reduced its diameter, has axially expanding slots which cut the surface of the collet alternately from both the sides including its top end side and its rear end side, and a fastening operation of the fastening nut allows the collet not only to be fitted into the taper hole in a pressable manner but also to be reduced its diameter, thereby fastening and fixing the tool which is fitted into the collet in an insertional manner. As the prior art of Fig. 9 illustrates, while an annular groove 2 is provided around the external periphery on the top end side of the collet 1 and an outward flange 3 is formed on the top end part of the collet 1, an inward flange 5 is formed around the internal periphery of the fastening nut 4, and, consequently, such a holding of the inward flange 5 into the annular groove 2 as shown by a dashed line of the same figure permits the collet 1 and the fastening nut 4 to be detachably connected to each other.

The collet 1 is fitted into the taper hole of the main body of the chuck and the pressing or drawing action of the fastening nut 4 causes the collet 1 to be mounted to or detached from the taper hole.

Since the tool capable of being mounted by way of the collet into the main body of the chuck is limited to the type whose diameter of a shaft to be mounted therein is adequately adaptable to the possible scope of reducing the internal diameter of the collet by fastening the collet with the fastening nut, if a change between the tools to be mounted into the main body of the chuck, which have a marked difference in the diameter of their shafts to be mounted therein, is made, there is a necessity of making a replacement with the collet whose internal diameter is equally corresponding to such a change. In that case, in order to mount or detach the collet 1 to or from the fastening nut 4, the prior art of Fig. 11 requires the collet 1 to be entirely reduced its diameter at least to the extent of the difference in diameter S1 between the maximum external diameter d1 of the outward flange 3 and the internal diameter D1 of the inward flange 5. But, since the necessity of providing a margin to be held between both the flanges 3 & 5 even in the case where the diameter of the collet 1 is minimumized so that the collet 1 may be drawn out from the main body of the chcuk, while the collet 1 is being accompanied with the fastening nut 4 in a pulling manner, results in the definition of the difference in diameter S1 to a considerably long extent, the mounting or detaching of the collet 1 to or from the fastening nut 4 may need an extremely large amount force for the reduction of the diameter so that there is a difficulty in replacing only the collet in the progress of the exchange between the tools.

Accordingly, the purpose of the present invention is to provide the collet chuck capable of mounting and detaching the collet to and from the fastening nut by a small force.

The further purpose of the present invention is to provide the collet chuck in which a high speed rotation of the spindle during the cutting work does not give rise to vibration of a cutting blade, an entire balance of its shape is kept, and a suitability for the precision maching substantially comes true.

The still further purpose of the present invention is to provide the collet chuck whose manufacturing is enabled to simplify the construction and is not costly with the afore-mentioned purposes attained.

Fig. 1 is a longitudinal sectional view of the first embodiment according to the present invention wherein the fastening nut is in a state of being relaxed;

Fig. 2 is a sectional view taken on the line II-II of Fig. 1;

Fig. 3 is an end view taken from the top end side of the collet;

Fig. 4 is an end view taken from the base end side of the fastening nut;

Fig. 5 is a longitudinal sectional view of the state of maximumizing the fastening force of the fastening nut;

Fig. 6 is a longitudinal sectional view illustrating an operation of connecting the collet and the fastening nut to each other;

Fig. 7 is a typical sectional view illustrating a movement of the collet made at the afore-mentioned connecting operation;

Fig. 8 is a longitudinal sectional view of a further embodiment according to the present invention; and

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Fig. 9 is a longitudinal sectional view of the collet chuck according to the prior art.

Description of Embodiments of the Invention

Referring to Fig. 1, the numeral 11 desinates the main body of the chuck having not only a taper shank 11a at its rear end part but also the taper hole 11b becoming tapering in proportion to an advance toward the rear area thereof at the inside of its top end side. The numeral 12 desinates the collet having the taper surface 12a becoming tapering in proportion to the advance toward the rear area thereof around its external periphery. And the numeral 13 desinates the fastening nut which is detachably connected to the collet 12 and, at the same time, is detachably screwed on the main body of the chuck 11.

The collet 12, approximately cylindrical shaped, has a hole into which the tool is fitted 12c at its inside, the hole 12c being coaxial with a virtual central axis of the collet 12, the expanding slots 14, 14, & 14,..... which cut the surface of the collet 12 are formed alternately from both the sides including its top end side and its rear end side with 8 lines of slots being made per the overall one group of directions. Providing of the annular groove 15 around the external periphery near to the top end side of the collet 12 has the outward flange 16 coaxial with the virtual central axis of the collet 12 formed at the top end part of the collet 12. A taper surface 12b whose inclintion takes a direction opposite to that of the taper surface 12a is formed at the external periphery surface of the top end part of the collet 12.

The fastening nut 13 has a female screw 13a threaded around its internal periphery near to the base end side so that the female screw 13a is screwed with a male screw 11c which is threaded around the external periphery near to the top end side of the main body of the chuck 11. The internal periphery near to the top end side of the fastening nut 13 is equipped with the taper surface 13b whose angle of inclination is identical to that of the taper surface 12b near to the top end side of the collet 12, the annular groove 17 coaxial with the virtual central axis of the nut 13 is formed around the position more internal than the taper surface 13b, and a pair of inward flanges 18a and 18b are provided at the positions respectively opposite to each other in a radial direction and being adjoining to the annular groove 17. These inward flanges 18a and 18b are provided such that the internal diameter D1 between them (Fig. 5) is smaller than the external diameter d2 of the outward flange 16 (Fig. 5) which is established when the mounting of the collet 12 is made with its diameter being shrinked in an under-mentioned manner and, at the same time, distances from the axial center O to the inward flanges 18a and 18b are different from each other : As illustrated in Fig. 2, 4-A, and 4-B, one of the distances is equal to h1 and another thereof is equal to h2, in other words, projecting amounts of both the flanges 18a and 18b are defined to $\ell 1$ and $\ell 2$ being different from each other as illustrated in Fig. 2. The internal peripheral sections 19 and (cutout sections) excluding both the flanges 18a and 18b of the nut 13 have the internal diameter D2 between them (Fig. 4-A and 4-B) defined larger than the external diameter d1 of the outward flange 16 when the diameter of the collet 12 is increased (i.e. when the collet 12 is removed from the main body of the chuck 11.)

The collet 12 and the fastening nut 13 are connected to each other under the state where while the inward flanges 18a and 18b of the fastening nut 13 are held into the annular groove 15 of the collet 12, the outward flange 16 of the collet 12 is held into the annular groove 17 of the nut 13 at the same time. Subsequently, fitting the taper surface 12a of the collet 12, which is in such a connecting state, into the taper hole 11b of the main body of the chuck 11 and fastening of the fastening nut 13 onto the main body of the chcuk 11 permit the collet 12 to be pressed at its taper surface 12b on the top end side to face the taper face 13b of the nut 13, the collet 12 entering in a pressable manner into the taper hole 11a together with its diameter entirely reduced by the decrease of the width t of the expanding slots. For this reason, when an execution of the afore-mentioned fastening operation follows the insertional fitting of the shaft to be mounted of the tool into the hole into which the tool is fitted in an insertional manner 12c of the collet 12, the reduction of the diameter of the hole into which the tool is fitted in an insertional manner 12c allows the tool to be fastened and fixed.

The internal diameter D1 between a pair of inward flanges 18a and 18b being opposite to each other of the fastening nut 13 is defined smaller than such an external diameter of the outward flange 16 of the collet 12 under the state where the nut 13 is maximumly fastened as shown by a solid line of Fig. 5, i,.e. the minimum external diameter d2. Relaxing of the nut 13 from the afore-mentioned maximum fastening state in which the corresponding dimensional relation, $D1 < d2$, gives rise to ℓa and ℓb of margins to be held between both the flanges 16, 18a, and 18b, followed by the axial movement of the collet 12, permits the collet 12 to be automatically pulled out from the taper hole 11b. The interval between opposite cutout sections 19 and 19, the internal peripheral sections excluding both the flanges 18a and 18b of the fastening

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nut 13, i.e. the internal diameter D2 (Fig. 4A and 4B) between the cutout sections 19 and 19 is defined larger than such an external diameter, i.e. maximum external diameter d1 of the outward flange 16 of the collet 12 under the state prior to fastening of the nut 13 as shown by the dashed line of Figs. 1 and 5. Namely, these dimensional relations are represented by D2 > d1 > d2 > D1 and the resulting defintion is that even when the outward flange 16 is at the minimum external diameter d2, the collet 12 does not reach its limiting smallest diameter with intervals left between the expanding slots 14.

In the collet chuck of the afore-mentioned construction, as shown in Fig. 6, mounting and detaching of collet 12 to and from the fastening nut 13 can be easily done by means of making the pertinent fitting in such a manner that the collet 12 is twisted from its position inclining from the virtual central axis into the nut 13. Namely, because of D2 > d1, in order to make connection, a utilization of the space between the cutout sections 19 and 19 may enable the almost all the area of the outward flange 16 to be inserted into the side of the annular groove 17 of the fastening nut 13, while the collet 12 is taking a slightly inclining posture. Subsequently, upon holding the outward flange 16 in a fitting manner into one 18a of a pair of flanges 18a and 18b whose projecting amount is larger than that of another 18b, there takes place a surplus space the length of which is m between the latter inward flange 18b whose projecting amount is comparatively smaller and the outward flange 16, in response of which such a forward and backward rotation of the collet 12 as shown by arrow of the same figure may provide a simple operation of reducing the diameter of the collet 12 only to the extent of a convertible value S2 in a radial direction of the collet 12 equally as long as m with a possiblity of housing fully the entire part of the outward flange 16 into the annular groove 17, thereby completing the connection. In that case, the amount of reducing the diameter thereof S2 needs only to be extremely smaller in comparison with that of reducing the diameter thereof S1 necessary for making the pertinent connection under the construction of Fig. 9 as well as, as shown in Fig. 7, only 4 pieces in total consisting of two groups of two pieces opposite to each other in a radial direction among 8 pieces located at the top end side of the collet 12 have only to make a displacement simply by S2 / 2, so it is possible that the extremely small amount of force is only required for assuring the mounting and detaching to be easily made.

Referring to Fig. 8, which illustrates a further embodiment according to the present invention, the structure of this embodiment is approximately identical to those of the afore-mentioned embodiment.

Namely, the collet 12 and the fastening nut 13 are connected to each other under the state where while the inward flange 18 of the fastening nut 13 is held into the annular groove 15 of the collet 12 with the help of the cutout sections 19 and 19, the outward flange 16 of the collet 12 is held into the annular groove 17 of the fastening nut 13 at the same time. Fitting of the taper surface 12a of the collet 12 being in such a connecting state into the taper hole 11b of the main body of the chuck 11 and fastening of the fastening nut 13 onto the main body of the chuck 11 permit the collet 12 to be pressed at its taper face 12b on the top end side to face the taper surface 13b of the nut 13, the collet 12, reduced entirely its diameter, entering into the taper hole 11b in a pressable manner, thereby fastening and fixing the cutting tool in the hole into which the tool is inserted 12c. It is identical to the afore-mentioned embodiment that the relation in which the inward flanges 18a and 18b and the cutout sections 19 and 19 of the fastening nut 13 and the outward flange 16 of the collet 12 are held into one another is represented by D2 > d1 > d2 > D1.

The features of the third embodiment lie in a forming of ceramic film 20 on almost entire surface of the collet 12 including the taper surface 12b on the top end part, the bottom face and both the inner side faces of the annular recessed groove 15, the taper surface 12a which is fitted into the taper hole 11b of the main body of the chuck 11, and both the end faces of the collet as well as on the sections including the taper surface 13b of the fastening nut 13, and the inner peripheral surface and both the side faces of the inward flanges 18a and 18b. The ceramic film 20 comprises an extremely thin film of nitride such as TiN or TiC. In the case of preparing such a ceramic film, in gerneral, a vaporing method in which the ceramic film is formed out of the vapor phase is used, the vaporing method including Chemical Vapor Deposition (CVD) depending on the chemical reaction and Physical Vapor Deposition (PVD) depending on the Physical technique such as vaporisation and the like. In the present embodiment, the latter PVD, particularly a vacuum vaporisation, may be preferably employed in preparing the ceramic film 20. Furthermore, the ceramic film comprising the thin film of nitride such as TiN and the like is of ultrahardness, being of superiority in wear resistance and hear resistance.

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The forming of the ceramin film on the surfaces of the collet and the fastening nut enables not only the wear resistance and the heat resistance of the collet chuck to be enhanced but also the nut to be smoothly rotated with a frictional resistance between the taper faces 12a and 13b being directly rubbed together reduced.

Claims

1. A collet chuck comprising the main body of the chuck having the taper hole at its top end side, a collet, capable of being reduced its diameter, having the taper surface which is detachably fitted into said taper hole on its external periphery, and a fastening nut which is detachably connected to said collet and, at the same time, is detachably screwed onto the main body of the chuck, thereby reducing the diameter of said collet with fitting the same into said taper hole in a pressable manner, characterized in that said collet has its external periphery on the top end part equipped with an outward flange coaxial with the virtual central axis thereof, said fastening nut has its internal periphery equipped with an inward flanges of an internal diameter which is smaller than the minimum external diameter of said outward flange, and a pair of cutout sections are formed at the positions opposite to each other in a radial direction of said inward flanges, said pair of inward flanges separated by the cutout sections are provided such that the distances from the virtual axis center of the fastening nut to the end margins respectively of both of said inward flanges are different from each other, i.e. the projecting amounts of both of said inward flanges respectively are different from each other, and the radial distance between said cutout sections is defined larger than the maximum external diameter of said outward flange at the time of increasing the diameter of said collet.

2. A collet chuck, as defined in Claim 1, wherein the internal diameter between a pair of inward flanges opposite to each other of the fastening nut is defined smaller than the external diameter of the outward flange of the collet at the time of fastening maximumly said nut.

3. A collet chuck, as defined in Claim 1, wherein a film of ceramic is formed on either and / or both of the surface of said collet and said fastening nut.

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FIG.1

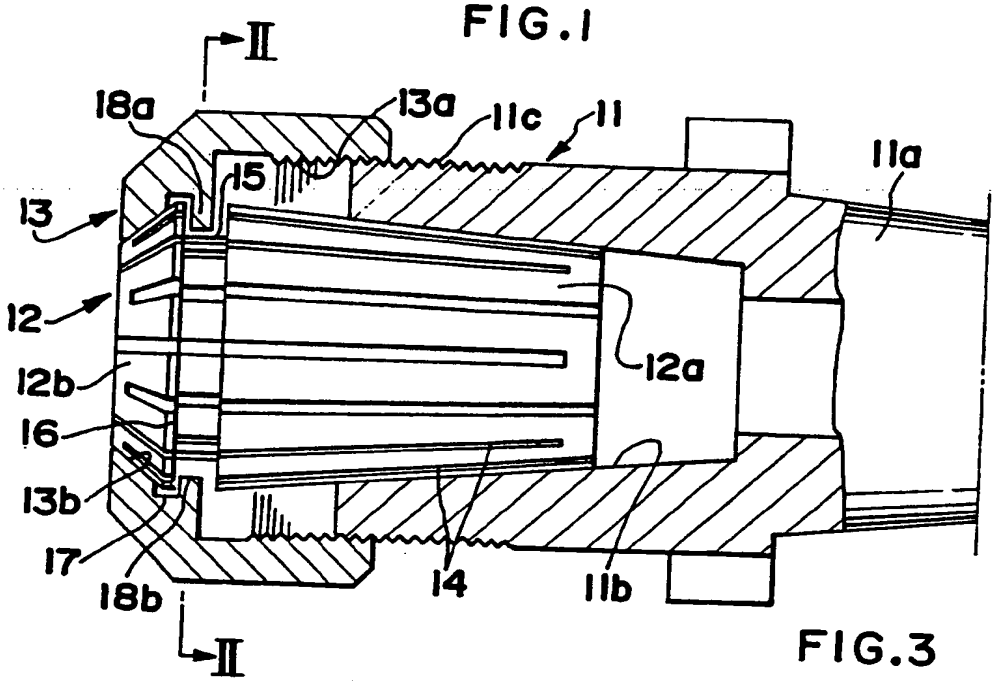

FIG.2

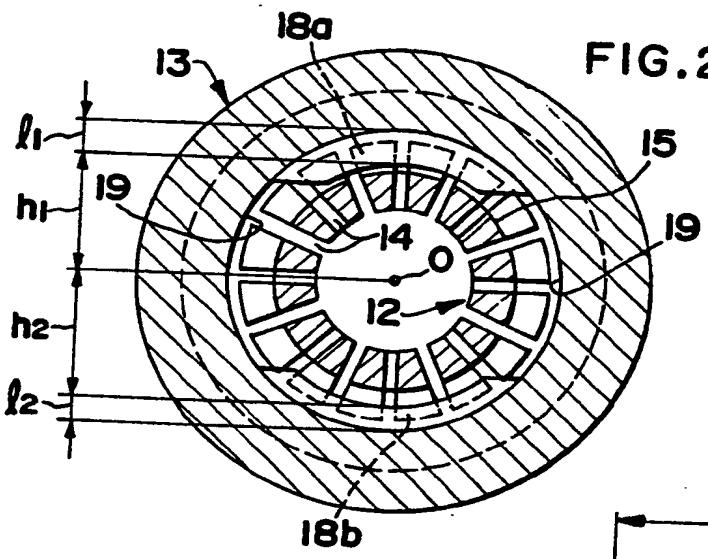

FIG.3

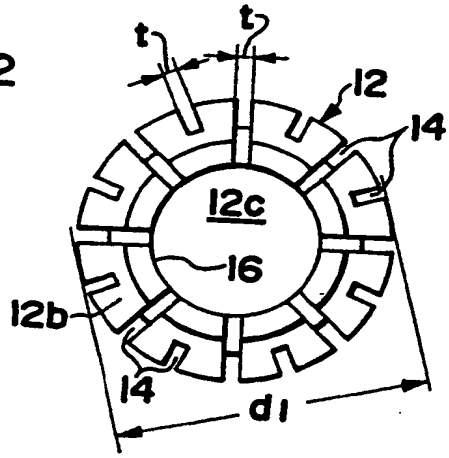

FIG.4A

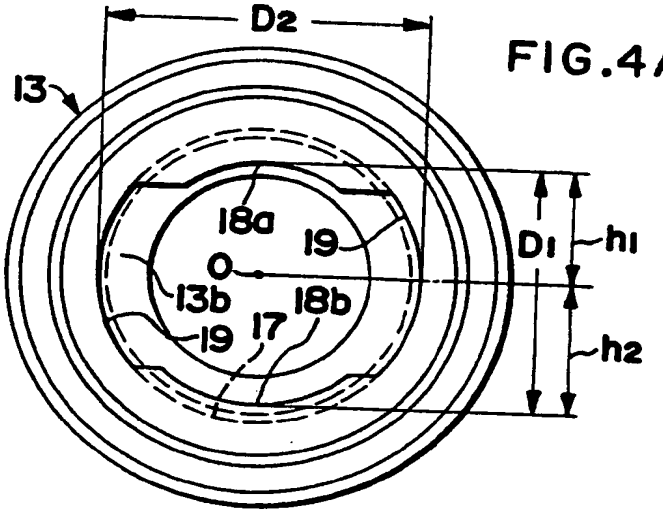

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FIG.4B

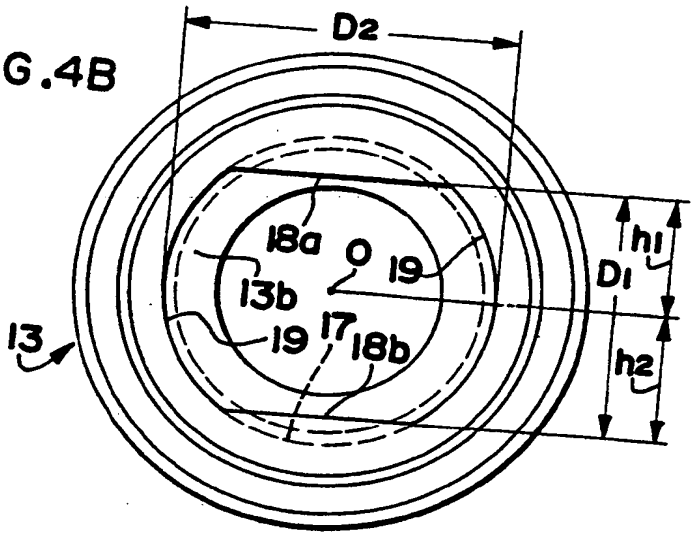

FIG.5

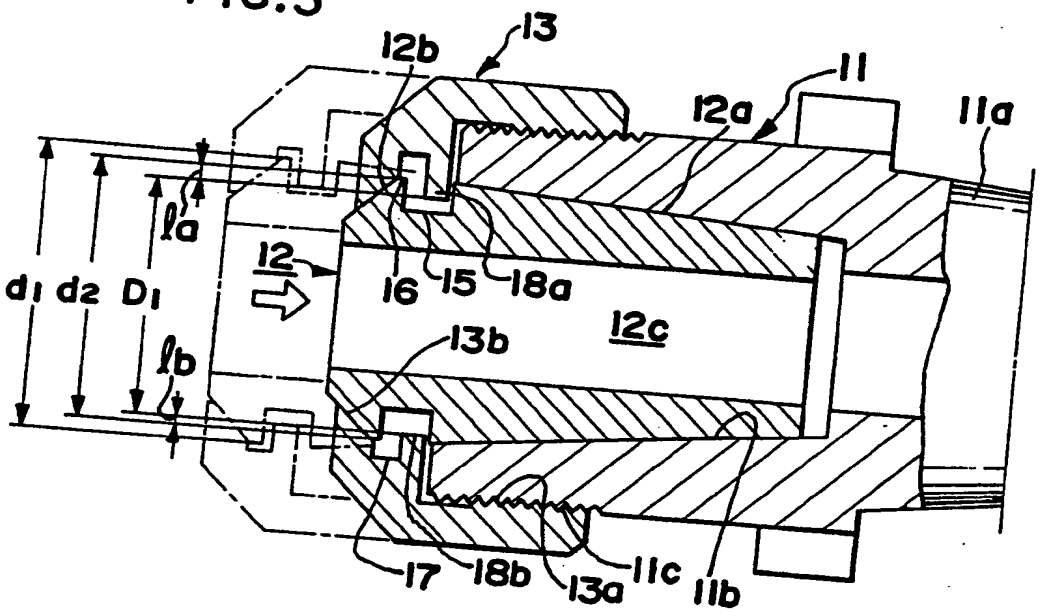

FIG.6

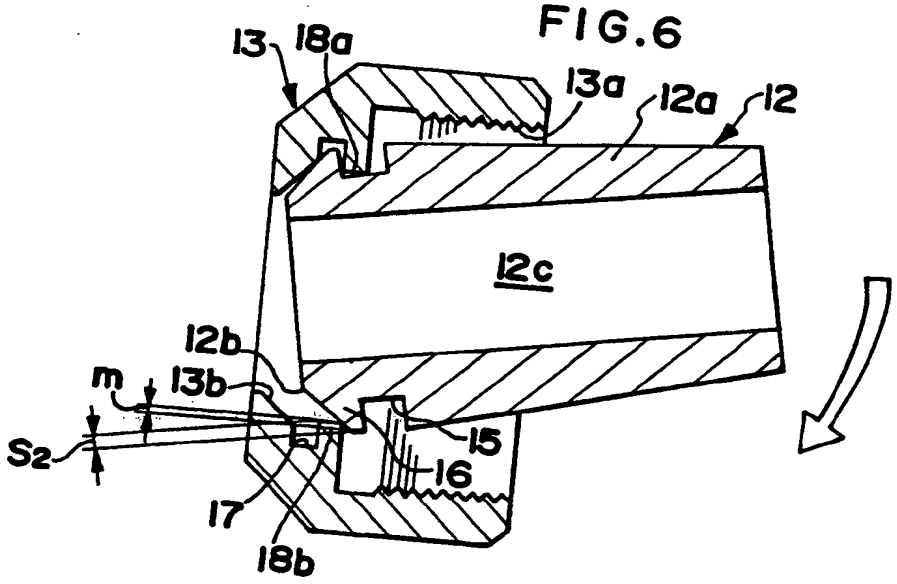

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FIG.7

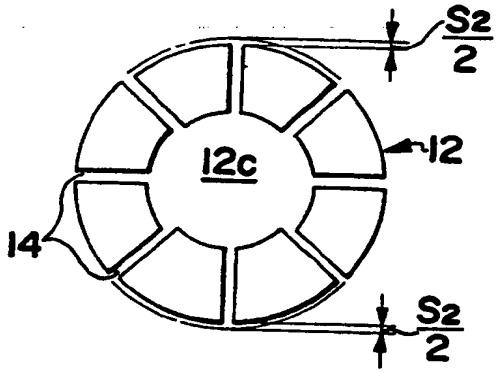


FIG.8

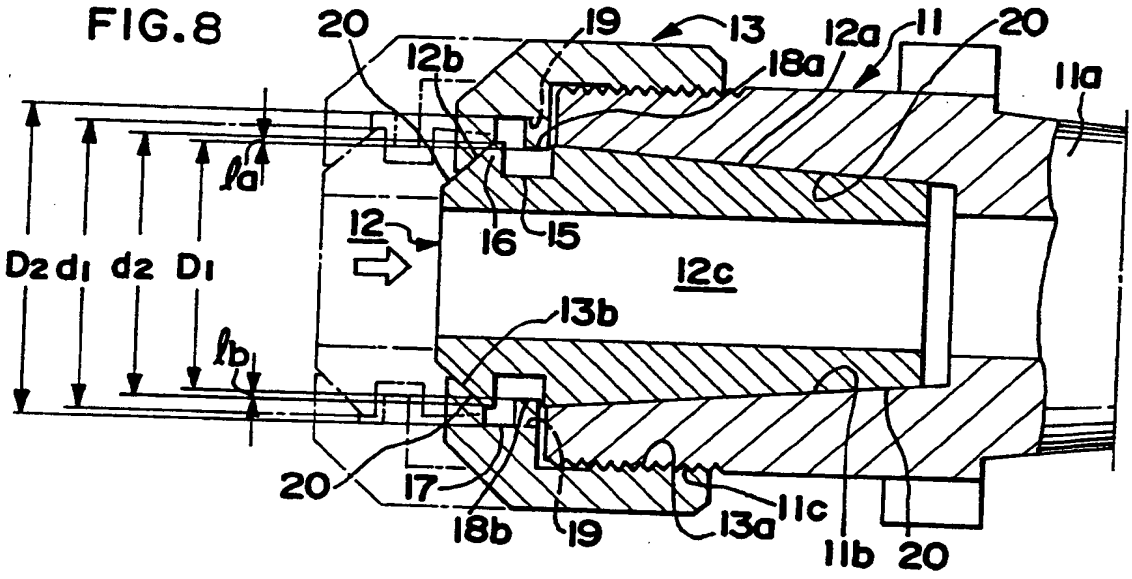
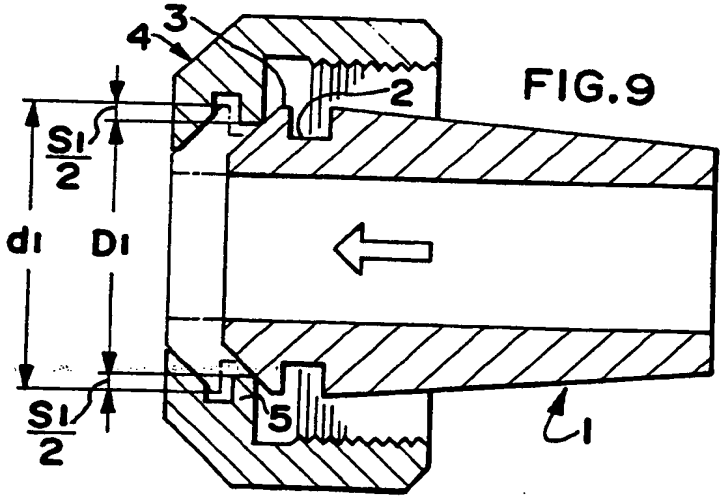


FIG.9



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EUROPEAN SEARCH REPORT

Application Number

EP 87 11 3328

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	CH-A- 557 211 (WEBER) * complete document *	1	B 23 B 31/20
A	US-A-1 973 942 (BUHR) * page 1, line 81 - page 2, line 14; figures 2-4 *	1	
A	US-A-3 451 686 (HAMMOND) * claim 1; figures 1-4 *	1	
A	DE-A-2 707 857 (TECNOPINZ) * page 6, claims 1-4; figures 1-4 *	1	
A	DE-C- 900 030 (ORTLIEB et al.) * claim; figures 1-3 *	1	
A	DE-C- 489 785 (GROSSET) * page 1, lines 26-40; figures 1, 2 *	1	
A	DE - B - 0 1283Ib/49a (ORTLIEB) * claims 1, 3 *	3	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 23 B 31/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	07-12-1987	MARTIN A E W

CATEGORY OF CITED DOCUMENTS

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